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Introduction

- Fructo-oligosaccharides (FOS) gained in the last years a large commercial interest due to its beneficial properties in the human health as prebiotics.
- Fermentative processes appear to be a good alternative for large scale production of FOS, that include kestose (GF2), nystose (GF3) and fructo-furanosylmaltose (GF4). However, the result of such fermentations is a complex mixture containing salts and low molecular weight sugars such as glucose (G), fructose (F) and sucrose (GF), that do not contribute to the beneficial effects and must be removed.
- Simulated moving bed chromatography (SMB) appears to be an efficient downstream process for the fractionation of sugars in an industrial scale. The major challenge when designing the separation process is the choice of an efficient ion-exchange resin. Therefore, the knowledge of the adsorption isotherms of the different compounds present in the mixture is an important parameter to consider when selecting the resin. Moreover, the influence on the adsorption of salts and other sugars present in the mixture must be studied.

Aims

- Modelling of the adsorption isotherms for FOS (from fermentative broth and pure mixtures) onto a Dowex Monosphere calcium resin.
- Determination of the model isotherm parameters using linear and non-linear correlations by minimization of several error functions.

Experimental Methodology

Resin Characteristics

Dowex Monosphere 99Ca/320	
Ionic form	Ca ²⁺
Structure	Gel-type
Matrix	Styrene-DVB
Functional group	Sulfonate
Total capacity (eq/L)	>1.5 (H ⁺ form)
Water content (%)	57-61 (H ⁺ form)
Volume median diameter (µm)	300-330

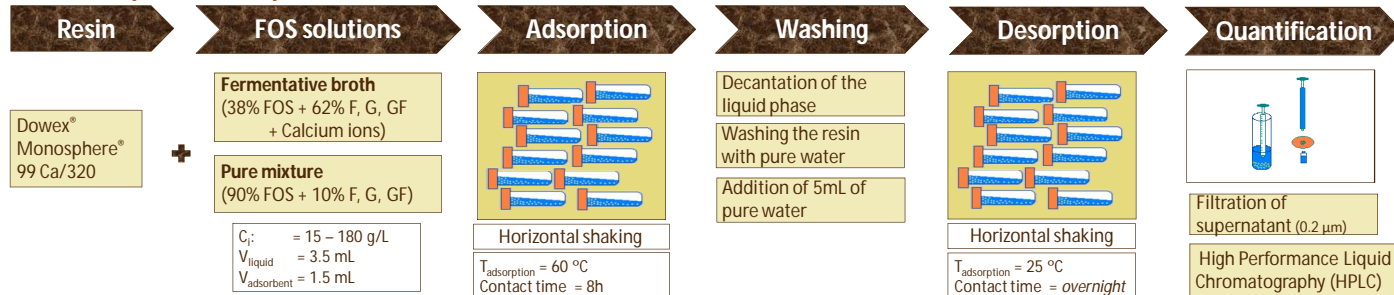
Isotherm Models

Curvature	Isotherm Model
Linear	Linear
Upward	Anti-Langmuir
	Langmuir
	Freundlich
Downward	Redlich & Peterson
	Toth

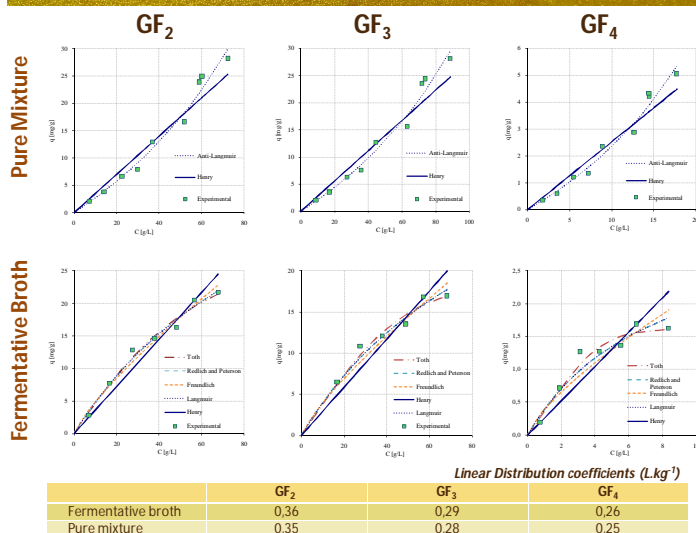
Isotherm Parameters Determination

Linear Correlation	Non-Linear Correlation	Error Function
Linearization of the Model Equations	Minimization of several error functions	Sum square of the errors
		Hybrid fractional error function
		Marquardt's percent standard deviation
		Average relative error
		Sum of absolute errors
		Smaller Sum of the Errors
		Best fitting of the experimental data

Static - Adsorption /Desorption Method



Results



Conclusions

- FOS present in pure mixture or broth have different adsorption behaviors.
- High ionic strengths and high concentrations of the other sugars seems to influence the adsorption.
- Toth*, *Langmuir* and *Redlich & Peterson* isotherms were the models that best represented the adsorption of FOS in the broth, while FOS in pure mixture were better represented by the *Anti-Langmuir* isotherm.
- For both mixtures studied, the sugars were adsorbed according to their molecular size and kept a constant selective behavior.
- The non-linear methods were found to be more adequate to estimated the isotherms parameters, being the HYBRID function the one that gives better the results.

References

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